AGRICULTURAL Research

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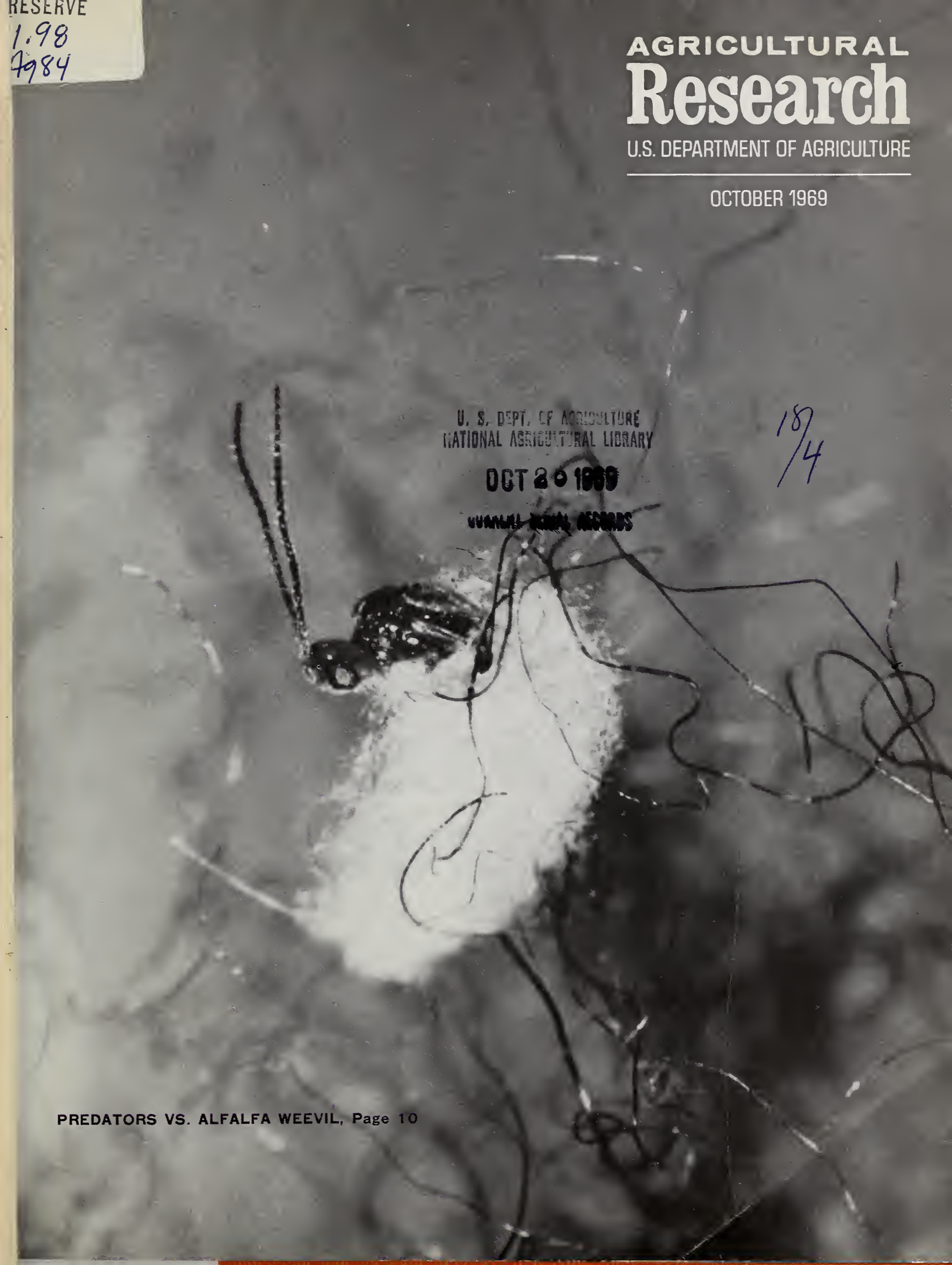

PREDATORS VS. ALFALFA WEEVIL, Page 10

AGRICULTURAL
Research

October 1969/Vol. 18, No. 4

Light Horse Renaissance

Horses declined so steadily after World War I that many observers relegated them to memory and legend. The eulogies were premature. In the last 6 years the number of horses has doubled and is now estimated at almost 7 million, a renaissance showing that Americans still cherish the light horse.

The exodus of the light horse from our roads marks one of the great changes of history. From the ancient days of chariots down to our own "horse and buggy" days the horse loomed large in providing transport and power. Now, since the advance of technology stilled the sound of hoofs on the road and in the furrow, one must go to agricultural fairs, horse shows, and trotting tracks to glimpse yesterday's aristocrats of harness.

Saddle horses have fared better. The cow horse continues to hold his own on the range. Racing is a flourishing industry. And the ranks of horseowners grow as more people take up showing, trail riding, fox hunting, steeplechasing, and ordinary pleasure riding.

As the horse population explodes, so do the problems of combatting equine diseases. The jet age has telescoped distance and time so that disease anywhere is a threat everywhere. Our primary defense is people, scientifically trained and technically competent, working together with an alert public.

ARS scientists and animal health officials conduct research on the diseases of horses and work to prevent the introduction of diseases from abroad. Among the major horse diseases under study are piroplasmosis and equine infectious anemia (also called swamp fever). And an exotic and potentially dangerous disease—African horsesickness—is under study in a high-security laboratory at Plum Island just off Greenport, N.Y.

Imported horses are held in separate quarantine quarters for at least 24 hours. They are treated for external parasites and examined for disease symptoms. Blood samples are taken, flown to Beltsville, and tested for glanders and dourine. Every animal must prove to be in good health before being released to its owner.

In modern times the horse still has its uses. ARS scientists join colleagues and horseowners in fostering the well-being of this animal which is so much a part of our heritage.

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

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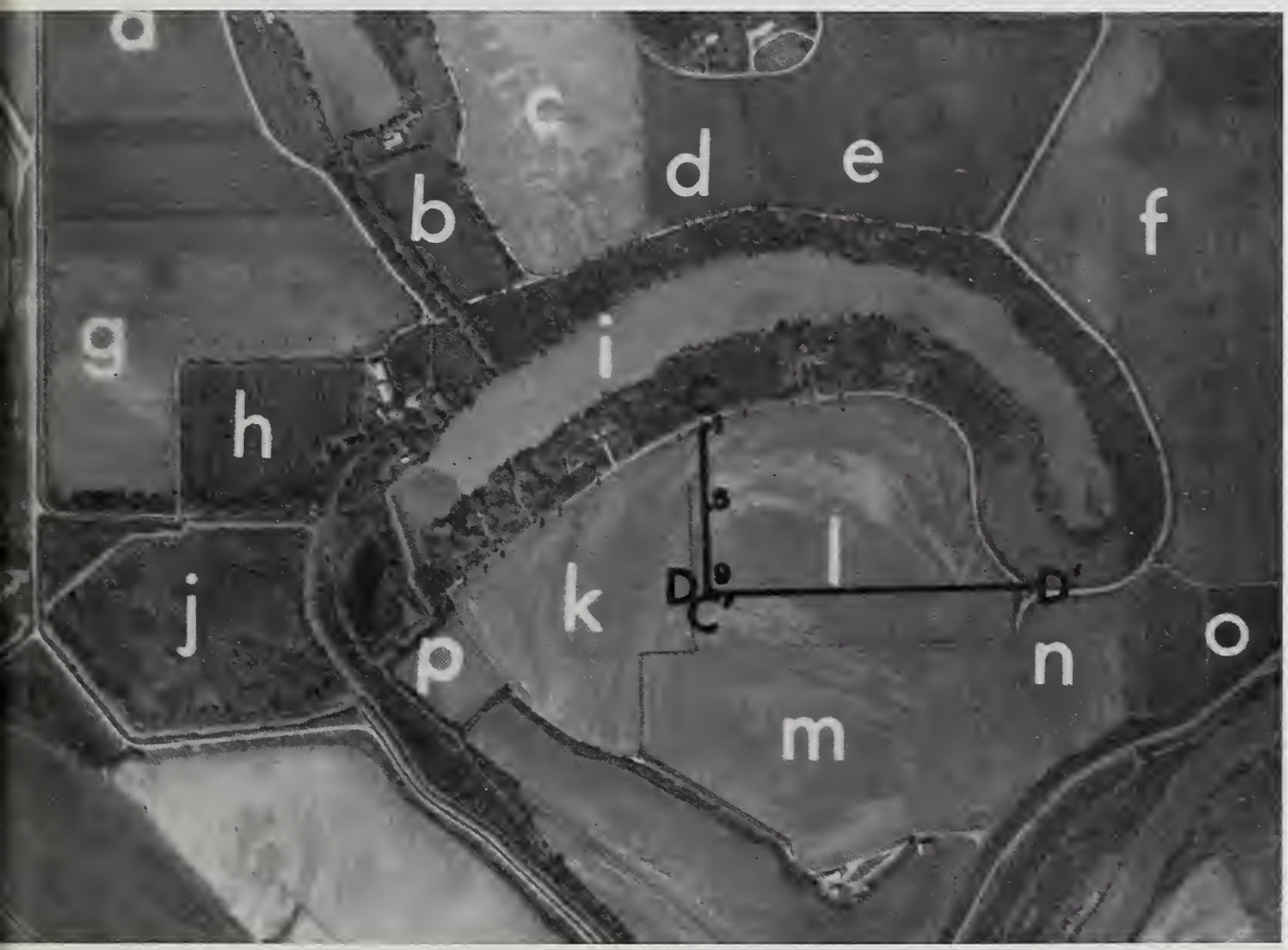
Thermogram showing relative surface soil temperatures of an alluvial floodplain near the Rio Grande River in Texas. Lightest areas have the highest soil temperature. Thermogram was produced by a cathode ray tube that converted data from multispectral scanners, generating an image line by line. Letters identify field areas (BN–34740).

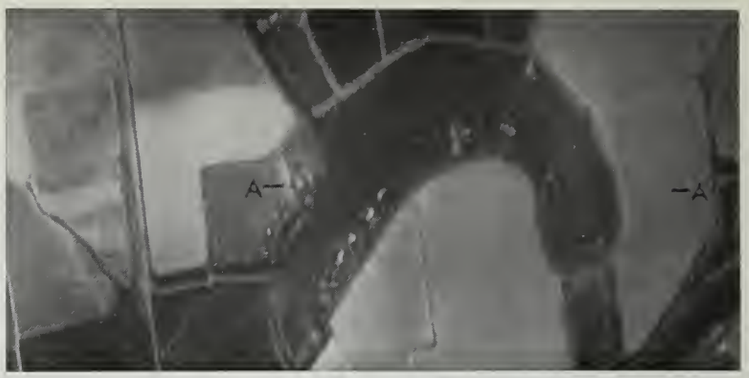


tomorrow's soil surveys

SOIL SURVEYS of the future will be assisted with thermal infrared sensors borne by aircraft or satellite.

This application of remote sensing should quickly and accurately reveal gross differences in texture and moisture condition of surface soils over broad areas. Only minimum supporting information would be required from conventional ground surveys.

Preliminary ARS investigations indicate that thermal infrared imagery can detect differences in surface soil temperatures and that these differences may be related to subsurface soil properties influencing the management of agricultural land. These studies at Weslaco, Tex., were in cooperation with the National Aeronautics and Space



Thermograms of the same location at 6:15 a.m., 2:00 p.m., and 7:00 p.m. The lake in center of each thermogram is warmer than surrounding soil at 6:15, cooler at 2:00, and warmer at 7:00 because water temperature remains relatively stable while soil warms and cools during the course of the day (BN–34744, BN–34739, BN–34738).

Administration, the University of Michigan, and the Texas Agricultural Experiment Station.

Former ARS agricultural engineer V. I. Myers and ARS soil scientist M. D. Heilman point out that the daily warming and cooling of soil is influenced primarily by moisture content, particle size and pore space. Temperature differences detected were related to differences in soil texture to a depth of 2 feet.

Their studies were made over a bare field in which soils vary from fine sand to silty clay. Laboratory analyses of 2-foot soil cores taken from selected sites in the field were used to determine distribution of particle sizes.

In general, sites where the profile contained zones of fine sand were lightest in tone (warmest) on thermal imagery from a mission flown at 7 p.m. For example, site A (50 percent sand, 27 percent silt, 23 percent clay) had a surface soil temperature of 62° C., while the reading at site E (12 percent sand, 32 percent silt, 56 percent clay) was 49° C. In other missions the same day, little temperature variation was indicated at 6:15 a.m. and only limited temperature contrast at 2 p.m.

Thermal infrared imagery from the 6:15 a.m. mission also showed surface soil temperature differences related to moisture content of the soil, but no contrasts were detected in the 2 p.m. and 7 p.m. imagery. A field that contained more moisture showed a temperature about 3° C. lower than an adjacent, drier field. Exact moisture data from these fields were not available.

Readings from another location showed that the daily oscillations of soil temperature can be a good indicator of gross soil moisture conditions. Differences between 2 p.m. and 6:15 a.m. readings at sites in a relatively dry field were 51° and 45° C., while the oscillations were 42°, 41°, and 40° C. in a field with more moisture.

The missions were flown at 2,000 feet by a University of Michigan aircraft equipped with multispectral scanners that record analog signals on magnetic tape. The tape-recorded data were later played back through a cathode ray tube that generates the image, line by line. The imagery resembles a photograph and is recorded on film. The differences in tone correspond to surface temperature variation—the lightest areas have the highest temperatures.

The scientists then scan the film positive with an isodensitracer that plots the measured optical density values in a two-dimensional tracing. Film density values of individual scan lines are then converted to line graphs for analysis.

The film density was directly related to measured (ground truth) temperatures at selected ground sites. Density readings can therefore be readily converted to equivalent soil temperatures.

Before remote sensing techniques can be used in identifying soil characteristics, much additional research will be needed, especially research on recognition of tonal patterns, texture, and cultural and subsurface conditions.■

Developed over 25 years ago, DDT was the first synthetic organic insecticide to be used on a global scale and is one of the 10 major insecticides in the world. It is economical, relatively safe to handle, and highly effective in controlling a vast array of insects.

But DDT has some undesirable characteristics that are of current major concern. Under some conditions, its residues are very persistent—they may linger long after DDT has accomplished its job. They usually decompose very slowly, are almost insoluble in water, and tend to accumulate in the fatty tissue of warm-blooded animals, including man. ARS scientists are trying to determine what happens to such persistent pesticides in soil, water, plants, and animals as part of USDA's program to prevent environmental pollution.

sunlight, oxygen and DDT Breakdown

NEW RESEARCH FINDINGS on the chemical alteration of DDT by ultraviolet light and oxygen mark a major achievement in understanding how this widely used pesticide degrades and changes in our environment.

For a number of years, scientists have known that the action of sunlight and air slowly destroys DDT. One important degradation product, DDE, is rapidly destroyed by sunlight and air, and scientists are aware of some factors within the molecule responsible for this difference in time. Another degradation product is DDD.

In laboratory studies spanning 3 years, ARS organic chemist J. R. Plimmer at Beltsville, Md., analyzed the degradation products formed when DDT was irradiated in a photochemical reactor and when it was placed under ordinary ultraviolet light. As DDT broke down, the products formed were separated by gas chromatography and then examined by mass spectrometry as well as by conventional chemical techniques.

Plimmer found that oxygen and ultraviolet light attack the DDT molecule, causing it to slowly loss some of its chlorine atoms. At the same time, they introduce oxygen into the molecule. This action transforms DDT into a mixture of other compounds that ultimately degrade into substances called substituted benzoic acids which would appear to pose no environment problems.

In addition to the known DDE and DDD, more than a dozen other products formerly unknown were identified through the use of a mass spectrometer combined with a gas chromatograph. These products will be investigated to determine their behavior in the environment.

The highly sophisticated equipment used permitted rapid and accurate identification of the makeup of minute amounts of the organic mixtures. It also reduced Plimmer's research time by one-half to one-fifth of the time necessary with other methods.

In continuing studies, Plimmer will move his experiments outdoors to test his findings under natural conditions.■

Plimmer (right) and ARS chemist U. I. Klingbiel insert a probe containing a sample into a mass spectrometer to check DDT breakdown (ST–5192–4).

Safflower oil for cooking?

A cooking oil that does not develop bad odors and film when held at high temperatures for long periods should be a strong competitor in the huge commercial and institutional cooking oil market—if quality and price are right.

Oil from a unique safflower variety named UC–1 apparently has this potential.

Commercial and institutional cooking, such as that in potato chip plants or restaurants, gives oil a severe stability test. Oils available in sufficient quantity to do the job get their stability by hydrogenation or other expensive processing. A few vegetable oils have natural stability under high temperatures, but they are more costly than processed oils. Among these, olive oil has the greatest natural stability.

UC–1 oil is similar to olive oil in chemical composition. And safflower is a crop easily grown in many parts of the western United States. UC–1 made a commercial appearance on a small scale in 1968 and acreage is expected to grow rapidly in the future.

"One problem remaining to be solved in utilization is that the seed cannot be differentiated from that of ordinary safflower," says ARS oil chemist Glenn Fuller, Western utilization research laboratory, Albany, Calif. Fuller is studying UC–1's chemical nature and industrial potential.

"UC–1 seeds look like most other safflower seeds. If other seeds got mixed with UC–1 and unprocessed oil from the mixture were used in commercial cooking, the oil would probably become rancid rapidly and develop a film."

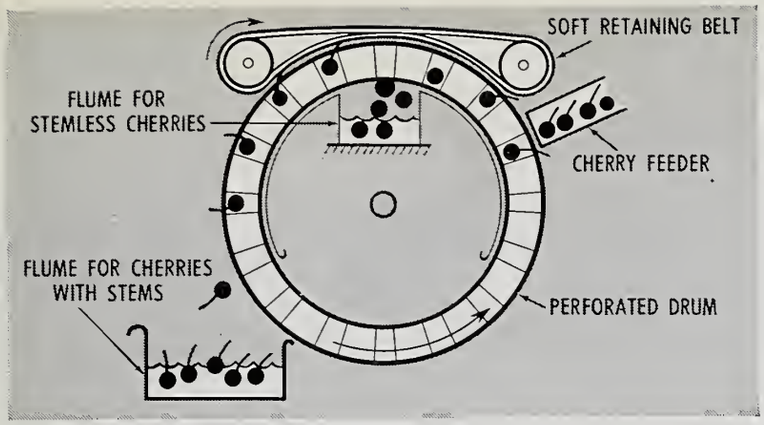
To solve this problem, plant geneticist P. F. Knowles of the University of California, Davis, is now developing variants of UC–1 with pigmented seed coats that can easily be distinguished from other safflower seeds.

Knowles first brought back the safflower seeds with the high-stability character from a plant exploration trip to the Far and Near East. He bred the character into a commercial variety and called the combination UC–1.

The genetic trait that gives UC–1 oil its unusual stability is the high content of oleic acid, a fatty acid. Oleic acid is present at various levels in the combinations of fatty acids that make up other vegetable oils. But until UC–1 was developed, olive oil had by far the highest level of oleic acid of any vegetable oil. Of the total fatty acids in olive oil, 80–82 percent is oleic acid, compared with 75–80 percent in UC–1.

The character that has traditionally given safflower oil its commercial value is a high level (75 percent) of another fatty acid, linoleic acid. An oil high in linoleic acid is not suitable for commercial frying because stability is lost under continuous high temperatures. UC–1 has about 12 percent linoleic acid, however, and olive oil, about 8 percent.

Oil high in linoleic acid is preferred by many if it is to be consumed, as a salad oil, for instance, because linoleic acid is known to have properties under certain dietary conditions of lowering blood cholesterol levels. Oleic acid seems neutral in this respect; it does not affect blood cholesterol one way or the other.■



for a GOOD maraschino . . .

machine sorts out stemless cherries

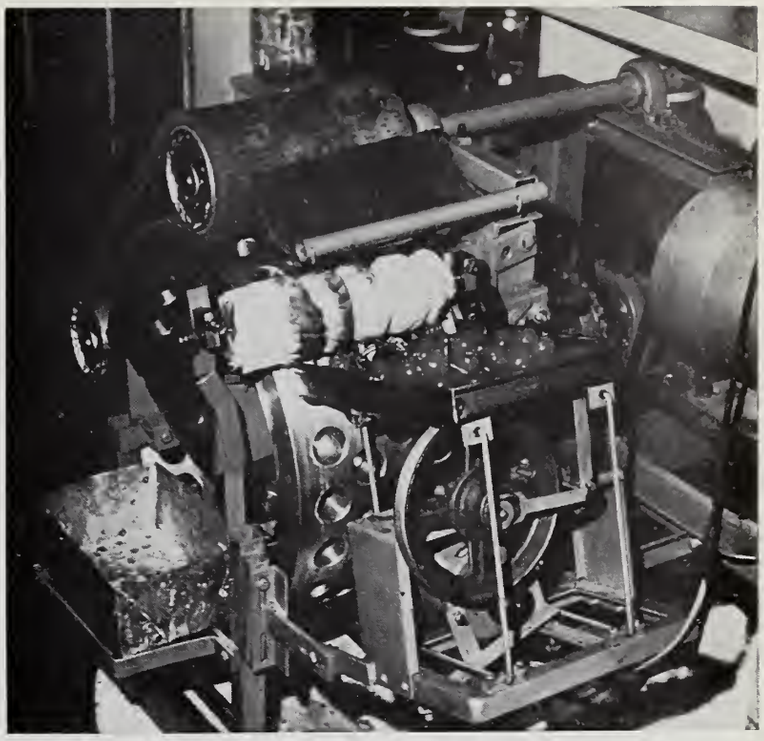


Diagram and prototype of sorter (PN–1823, BN–34742).

WHEN, WHERE, AND HOW the stems of cherries are removed makes quite a difference in their price.

Cocktail drinkers pay premium prices for maraschino cherries with stems because—among other things—they like to toy with the stem and cherry while unwinding from a busy day. For the fresh market, fruit with stems are more desirable because stems keep the cherries from drying out in transit and at the market.

Sweet cherries picked by hand contain almost all cherries with stems attached or almost all cherries without stems, depending on instructions given to the workers. Mechanical harvesting, however, results in a mixture of both. Until now, the only way of separating the fruit was costly, laborious hand sorting—an uneconomical step if the fruit contains between 20 to 80 percent fruit with stems attached.

An experimental separating machine, now being tested by ARS, may make it feasible for Michigan growers and processors to market cherries as premium or fancy pack and realize as much as $107 per ton (1968 prices) more for their efforts.

Tests of the machine showed that 98 percent of the fruit diverted to the maraschino bin (fruit with attached stems) had well developed, firmly attached stems. The Maraschino Cherry Association's acceptable standard is 96 percent. Fruit with stems attached, missed by the machine and going to the stemless fruit bin, had stems that were short, wilted, or curled, with less than 10 percent of them acceptable for the maraschino market.

The machine was developed by ARS agricultural engineers B. R. Tennes and J. H. Levin along with C. M. Hansen, agricultural engineer of the Michigan agricultural experiment station, East Lansing. It utilizes an aluminum drum 2½ inches thick with a diameter of 14½ inches. The drum is 5¾ inches wide with 1¼-inch holes drilled in staggered rows 2$^{1}/_{16}$ inches apart around its circumference.

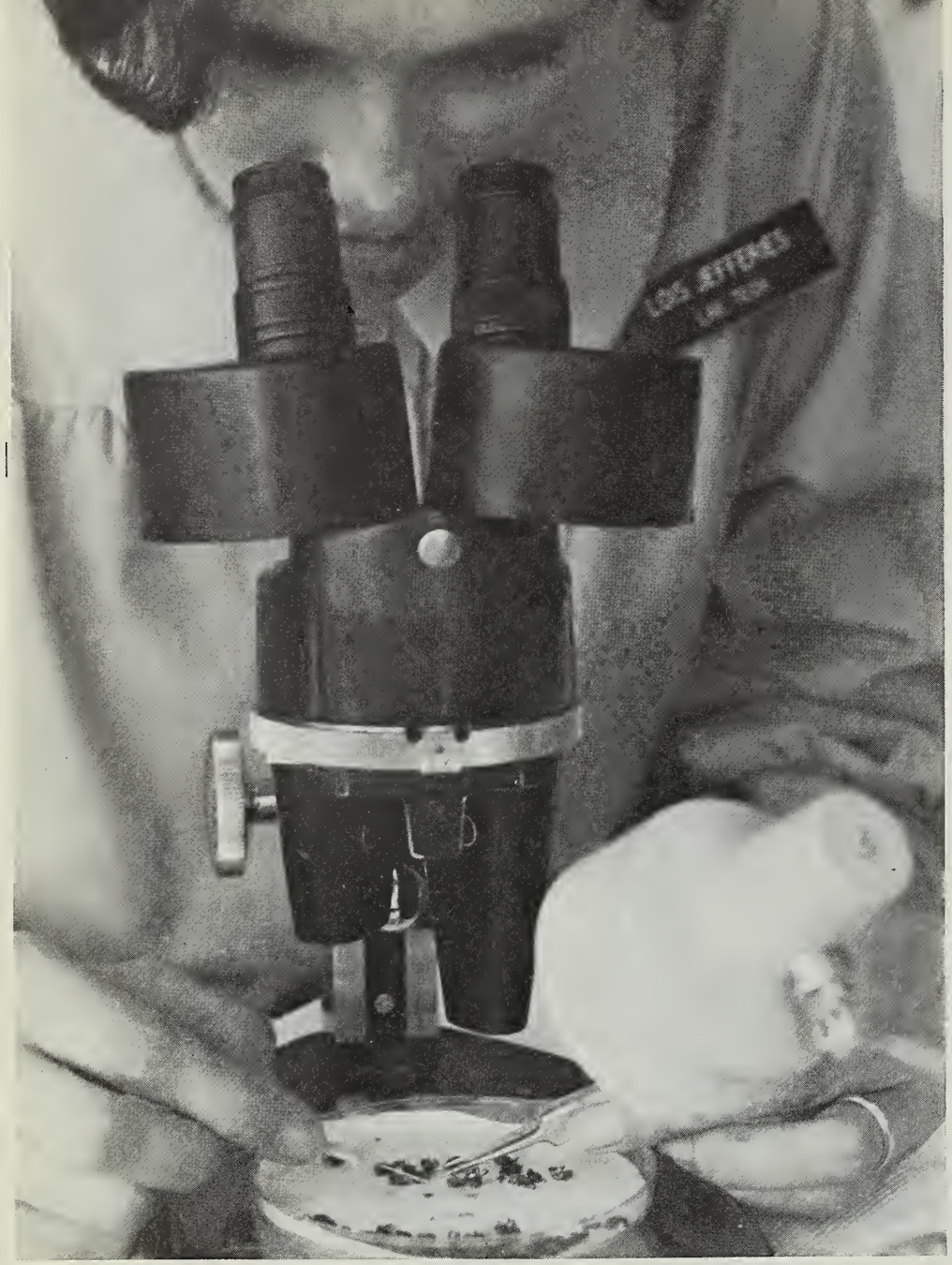
Cherries are fed into the drum's holes by an oscillating chute. Fruit with stems enter the holes fruit first with the stem extended outward. Those entering stem first are knocked out by the chute (since the stem keeps the fruit sticking out of the hole) and usually enter the next hole correctly.

An inside stationary retaining plate keeps the stemless cherries from falling through into the drum.

As the drum rotates at about eight revolutions per minute, it drives a soft, flat endless belt. The belt, revolving on pulleys, presses on the top third of the drum. Stems of cherries are caught between the outside of the drum and the soft belt and are carried around the drum beyond the end of the belt where they drop into a flume and are carried away from the machine. Near the top of the drum, inside it, is another flume. The inner retaining plate terminates near the top, and the cherries without stems, not being held by the belt, drop into the flume and are carried away.

Tests indicate that the machine will separate from 100 to 223 pounds per hour. By projection, the capacity of a drum 36 inches wide would separate from 625 to 1,400 pounds per hour.

Damage to cherries caused by the machine during the tests never exceeded 1 percent of the total pounds of fruit separated.■



Operation Boll
TRAPPING

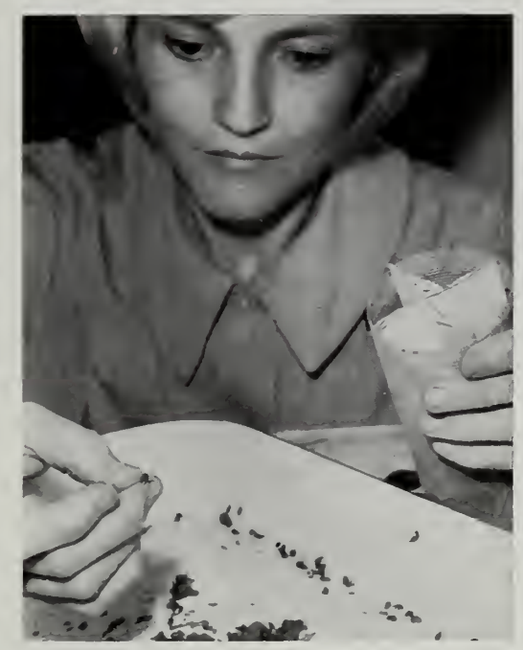
IT'S HOT, DIRTY WORK. But in country where leggings are worn over boots as protection against rattlesnakes, women—mostly wives of cotton farmers—are running some 26,000 traps to find out if boll weevils can be eradicated.

The large-scale field trial is underway in the Texas High Plains by ARS research and regulatory entomologists, the Texas Department of Agriculture, Plains Cotton Growers, Inc., the Cotton Producers Institute, and the Texas Agricultural Experiment Station.

The trial area covers about 1,800 square miles where some 40,000 acres of cotton are grown each year. The boll weevil invaded this area about 6 years ago but has been kept under economic control through a coop-

Above: *Technician Lois Jeffries checks weevil sample under microscope to make sure only males are used in traps (ST–5070–4).* ***Right:*** *Technicians Don Shaw (left) and John Cornell put about 800 cotton seeds into each flat of sand. Weevil must be fed if it is to live and emit the attractant, so cotton seedlings go into each trap (ST–5088–5).*

Left: Seedlings are inserted into nutrient-filled plastic tubes. A tube and weevil are added to each quadrant of cage (ST–5087–10). ***Center:*** *M. N. Griffin selects male weevil for trap (ST–5083–15).* ***Right:*** *In the field, Chris Durrett records capture of a weevil (ST–5086–4).*



Weevil THAT 1 PERCENT

erative spray program, which reduces the weevil population by about 99 percent each fall. It is all but impossible, however, to find and kill the few weevils that manage to survive the winter. These weevils mate and start rebuilding the population.

The aim of the field trial is to lure the few overwintering weevils to their own destruction before they can reproduce. The traps were first set out around April 1, in or near areas where weevils are prone to hibernate. Male boll weevils served as the lure.

The first weevil was trapped about 2 weeks later. Most weevils were caught during the last week of May and the first 2 weeks of June. Almost all weevils were caught in about 25 percent of the traps, which gave researchers a better idea of the type of terrain most conducive for trapping. By the time the traps were all removed about the middle of July, some 12,000 weevils were caught.

Male boll weevils used in the traps are replaced each week. The weevils are raised and sexed at ARS' Boll Weevil Research Laboratory, State College, Miss. To insure enough male weevils for the trapping program, the Mississippi laboratory produces at least 250,000 weevils each week.

During their week in the field, the male weevils are caged with cotton seedlings to provide food. The cotton plants are also needed by weevils to emit the natural compound that attracts male and female weevils to the traps.

The field trial is not a simple operation. Cotton seedlings must be grown, kept fresh in nutrient solution, and inserted with weevils into each compartment of the four-part cages used in each trap. Then the cages are capped, taped, and packed in cold chests. The prepared cages go to the women trappers who place them in the fields.

Cleaning, repairing, and coating traps with sticky material, and clearing and cleaning cages for reuse are also part of the operation.

The special trapping effort has materially reduced the boll weevil population. As of August 10, only a few fields representing less than 5 percent of the trapping zone's cotton acreage were lightly infested. But 5 miles beyond the trapping zone, the cotton-fields were virtually 100-percent infested.■

Cover: Newly matured wasp, Microctonus aethiops, *emerges from cocoon (BN–34628).* ***Above:*** M. aethiops *wasp follows alfalfa weevil until it can inject its egg-laying organ (BN–34627).*

alfalfa weevil bows to parasites

ALFALFA WEEVIL infestations have reached a turning point, and parasites may be one reason why. In areas where the pest has been established for more than 10 years, the amount of damage is declining.

The parasites are tiny, fragile wasps, harmless to humans. Thousands of them have been released in most States east of the Mississippi River by a team of ARS entomologists stationed at Moorestown, N.J., and Beltsville, Md. Cooperating in the project are scientists of State agricultural experiment stations.

Two of the most important wasps are *Bathyplectes curculionis* and *Microctonus colesi.* Both attack alfalfa weevil larvae in the spring when infestations reach their peak. *B. curculionis* females lay their eggs in the larvae, which spin cocoons before being consumed by the developing wasps. Weevil larvae parasitized by *M. colesi* wasps, however, become adults and are not killed by the parasites until the following spring.

M. colesi wasps parasitized about 30 percent of the larvae surveyed in New Jersey fields by ARS entomologists M. H. Brunson and L. W. Coles. *B. curculionis* wasps parasitized an additional 10 percent of the larvae.

After these wasps finish laying their eggs, another parasite—*Tetrastichus incertus*—takes on the alfalfa weevil, attacking until cold weather arrives. In years when weather conditions favor summer and fall development of the weevils, *T. incertus* has parasitized an average of 70 percent of the late summer brood of weevil larvae surveyed by R. W. Fuester in Pennsylvania. An average of five wasps may emerge from each parasitized weevil.

One of the most promising species—*Microctonus aethiops*—attacks adult weevils rather than larvae. It even provides control before killing the weevils: Parasitized female weevils stop laying eggs, reducing future generations. Surveys by W. H. Day indicate that *M. aethiops* parasitizes an average of 30 percent of the weevils in New Jersey. This species has been released in 20 other States, but so far is established only in New Jersey, Delaware, Pennsylvania, and Maryland.

Both *M. aethiops* and *M. colesi* deliver a double-barrelled attack against alfalfa weevils, adversely affecting reproduction before the weevils die. In laboratory tests, J. J. Drea found that developing parasites castrated their hosts—an effect that had been observed on other parasitized species but was not previously known to have a significant effect on alfalfa weevils.

After mating with parasitized males, about 55 percent of the female weevils laid eggs that failed to hatch. About 35 percent laid no eggs, and about 10 percent laid eggs of low fertility—only one in 10 hatched.

The fertile eggs were attributed to incomplete castration by the parasites. In many cases, the eggs contained perfectly formed weevil larvae, which died before hatching.

Drea found that the wasp larvae live in the male weevils' body cavities and do not directly attack the reproductive organs. Instead, they may rob their host of nutritional elements necessary for normal development of these organs—a theory that requires further research.

Drea dissected parasitized male

weevils and found that the insects' testes became progressively smaller as the period of parasitization increased. Testes of about 90 percent of the parasitized males could not be found or were under one-half normal size and contained abnormally large amount of fats.

In related experiments, Drea found that parasitized males had long-lasting effects on reproduction by female weevils. After mating with these males, and subsequently mating with normal males, only about one-third of the females' eggs hatched. Unidentified bacteria were found swarming in the eggs.

The Moorestown entomologists have broadened this approach to weevil control by releasing six other wasp species in 20 States. The combined effect of these parasites could greatly curb the weevils.

Moreover, the wasps represent a self-perpetuating system of control that could minimize future needs for insecticides which, unlike the wasps, sometimes pose hazards to honey bees, other beneficial insects and animals.■

***Left:** Coles sweeps field with net in survey for weevil parasites (BN–34625). **Right:** Testes of normal alfalfa weevil contrast with shrunken ones of parasitized weevil (CN–245).*

Predicting pear size

WILL THE CROP make the best market grade? Being able to answer this question before harvest can increase profits for fruit growers.

Fruit size at harvest has been predictable early in the growing season for peaches and apples. Now ARS plant physiologist M. W. Williams at Wenatchee, Wash., has devised a way for growers to make similar predictions for Bartlett pears with a reasonable degree of accuracy.

Twenty pear fruits on each of five trees in several orchards near Wenatchee were tagged and measured at regular intervals each year from 1959 through 1968. The correlation between fruit size at each date of measurement and fruit size at harvest was calculated from this sample.

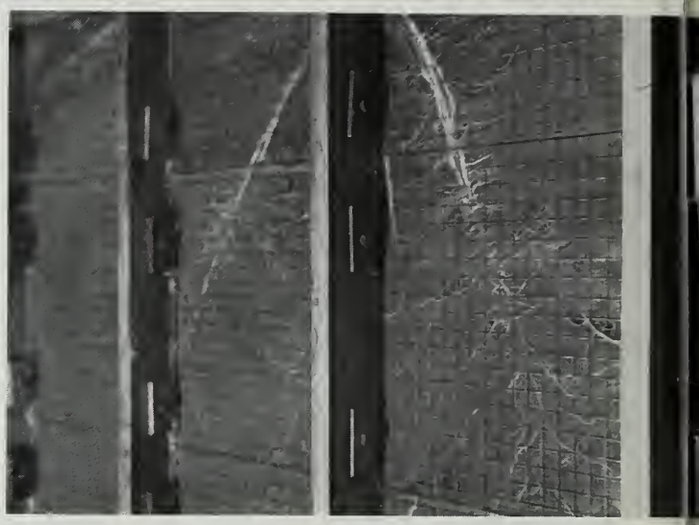
Williams prepared a Bartlett pear growth chart by averaging the fruit diameter measurements for the various size fruits from all test orchards from 1959 to 1968. Average growth curves were then constructed. The data indicate that a small fruit tends to grow at a slower rate than a large fruit. A small fruit at 60 days from bloom is still a small fruit at harvest.

Temperatures during the growing period also had a significant effect on the final fruit size. Temperatures between 55° and 75° F. appear ideal for an increase in fruit volume. As the temperature rises to 80° and above, fruit growth rates decrease. Evaporation rate is also correlated with fruit growth rate. As water evaporation increases, fruit growth rate decreases.

Predicting fruit size may begin as early as 60 days from bloom, although accuracy of prediction increases as the fruit approaches maturity. If trees are in good vigor, selection and diameter measurement of 10 fruits from each of 10 trees located at random in a 5-acre block is satisfactory for predictions that are accurate within ⅛ inch of actual harvest size. Greater accuracy requires a larger fruit sample. Where fruit size varies considerably from tree to tree in the block, additional trees divided according to fruit size should be sampled.

After averaging the diameters of the selected fruits, the grower refers to the growth chart and makes the necessary comparisons for accurate prediction of harvest size.

If too many fruits are in the small, undesirable size range, additional thinning or extra irrigation could improve the size of the fruit harvested.■



Left: *Rhizatron is 72 feet long, 13 feet wide, and 8 feet deep (BN–34734).* ***Top:*** *Entrance to rhizatron (BN–34737).* ***Bottom:*** *Part of corn root system viewed through ½-inch grid squares (BN–34736).*

the Rhizatron

SOME WAG is certain to refer to the new rhizatron at Auburn, Ala., with words like "tunnel vision," "mole's eye view," or even "science goes underground."

But the ARS rhizatron—"rhiza" meaning root and "tron" meaning instrument—is there for the serious purpose of finding out more about the way roots grow. ARS soil scientist H. M. Taylor says researchers hope to learn the cause of poor root growth in the subsoil brought about by acidity, nutrient deficiency, inability of roots to penetrate a compact soil layer just below plow depth, or a combination of these conditions (AGR. RES. Nov. 1963, p. 6).

Root growth is difficult to study, so researchers often concentrate on top growth. The rhizatron, however, will permit studies of the interaction between roots and tops, and because of its flexibility, will allow soil scientists to better evaluate soil management effects on root and top growth.

It will also bridge the gap between short-term intensive study of roots in the growth chamber and field experiments where root size, shape, and number are observed only once or twice in a growing season.

A basement-like excavation, the rhizatron has 20 window-fronted soil bins along two sides—10 on each side. Bins measure about 74 inches high, 48 inches wide, and 24 inches from front to rear along the top. Ten bins are inclined about 10 degrees from the vertical so taproots will stay in the soil along the glass windows. These bins measure 12 inches from front to rear at the bottom.

The initiation, growth, development and death of roots can be studied and measured through the windows by direct observation, by viewing through the microscope, or by time-lapse photography. Soils in the bins can be changed at will by removing the glass windows and transporting soil via a belt elevator installed at one end of the structure.

The rhizatron is equipped to monitor and continuously record oxygen content in aeration studies, soil and air temperatures, and soil water status at various points within a bin. Other specialized measuring equipment can be added as required.

The ARS rhizatron is a modified version of one built at Kent, England, but the Auburn version provides researchers with more precise control of soil environment. The Alabama Agricultural Experiment Station is cooperating in the project, and Auburn University donated the land on which the rhizatron is built. ■

Critical depth flumes CALIBRATED BY COMPUTER

CRITICAL DEPTH FLUMES, known as a reliable way to measure irrigation water distribution and watershed runoff, can now be calibrated through equations solved by computer.

By continuously metering the water going through the flumes, irrigators or irrigation districts have an accurate record of water use, and hydraulic engineers can determine how much water is running off a watershed.

Developed by ARS hydraulic engineer J. A. Replogle at Phoenix, Ariz., the computer-solved equations eliminate laborious, expensive, and time-consuming laboratory calibration.

Critical depth or flow is the depth at which a given channel and given quantity of water flows at minimum energy. Water going over a dam is at critical depth when it reaches a point of free flow just before it starts to fall. At subcritical depth, water is still being held back by the dam, while at supercritical depth or flow, water is dropping freely or shooting down a slope. At critical depth, a given flume opening and a given depth (head) of water will free the same volume of water time after time, since gravity is the main force involved.

Critical depth is created in flumes by passing a head of water through a channel or throat. The throat in critical depth flumes has parallel sides in the critical depth region, a level bottom, and a cross-section that can be "V" shaped, rectangular, or trapezoidal (flat bottom with sloping sides).

Much of the basic theory concerning the flow characteristics of critical depth flumes has long been known. In the past, it was just as easy to calibrate the flumes in the laboratory as it was to apply the theoretical knowledge in tedious, detailed computations. Replogle, however, brought computers to bear on the problem, doing away with the "by hand" computations and making them more or less routine.

Other types of flumes may not conform to Replogle's equations because of their configurations. Such flumes are limited to particular sizes and shapes, while the calibration for the critical depth flumes studied by Replogle can be computed for a wide variety of basic shapes.

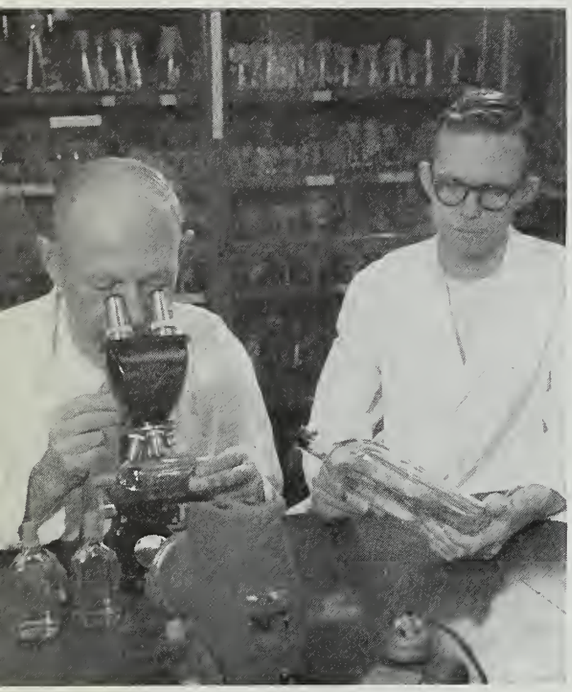
Hydrologists are attracted to critical depth flumes because:

1. They do not have to be calibrated in the laboratory.
2. They have sufficient accuracy for most applications over a wide range of discharges.
3. They are sturdy, economical, easy to build, and need only minimum maintenance.
4. They offer little obstruction to passage of sediment.■

Replogle takes measurements of water coming out of critical depth flume to back up computer equation (BN-34643).

new cell line to isolate

FMD VIRUS



Microbiologist C. J. DeBoer and veterinarian T. L. Barber at Plum Island examine tissue culture bottles in which the virus is being propagated (BN-34743).

A CELL LINE obtained from pig kidney tissue has proved a useful tool for isolating foot-and-mouth disease virus (FMDV).

Cell lines are obtained by continuously subculturing animal tissue cells. Although many cell lines have been obtained throughout the world, only a few of those tested are susceptible to FMDV. Often, the cells fail to multiply and die after a certain number of continuous subcultures (cultures derived from pre-existing cultures). But the line called IB–RS–2 has been found to be susceptible to FMDV and stable—it can be subcultured indefinitely.

Cell lines are easier and less expensive to make than cultures, which must be prepared each time directly from animal tissues. The susceptibility of cell lines to virus is more constant, and the lines can be easily stored by freezing for future experiments.

The research was conducted by the Biological Institute, São Paulo, Brazil, under a Public Law 480 grant from ARS. Directed by principal investigator M. P. de Castro, the Brazilians worked with FMDV samples taken from infected animals in the field. ARS' Plum Island Animal Disease Laboratory cooperated in the research.

Castro found IB–RS–2 effective in measuring the amount of FMDV in a sample—even when the sample contained only small numbers of infectious virus particles—and for measuring antibodies against FMDV. As the line was developed, important cell chromosome changes occurred that could have affected susceptibility to FMDV but apparently did not.

Unlike some cell lines, IB–RS–2 can be grown with very simple, inexpensive media and may prove valuable for producing large amounts of virus for vaccine preparation.

Use of the IB–RS–2 line is under further investigation at Plum Island. Veterinarian J. J. Callis, director of the Plum Island laboratory, and microbiologist C. H. Campbell were ARS sponsoring scientists for this 5-year project.■

Tomato line resists curly top

A NEW TOMATO breeding line sustained losses of only 5 to 10 percent in areas where tomato crops had almost been wiped out by curly top virus.

The new line, C5, exhibited the high level of resistance to curly top virus (CTV) in 5 years of testing by ARS plant geneticist M. W. Martin stationed at Prosser, Wash. The Utah and Washington agricultural experiment stations cooperated in the research.

C5 is now being released to other tomato breeders. Although considered only a source of germ plasm and not a finished variety for commercial evaluation, it possesses the CTV resistance that is necessary to successfully produce tomatoes throughout the intermountain area.

Currently, the tomato canning industry in eastern Oregon, Washington, and the Intermountain States routinely suffers 15- to 25-percent losses from CTV. Occasionally severe epidemics cause losses up to 80 percent of the crop in local areas. And some potential production areas do not grow tomatoes because of the danger of curly top.

Other tomato varieties and breeding lines, partially resistant to CTV, have been released from the ARS and Idaho programs. However, there have been inconsistencies in their resistance, and none has sufficient resistance to withstand the extremely severe exposure to CTV that occasionally occurs in the intermountain area.

In addition to CTV resistance. the new line has some of the horticultural characteristics important in machine harvesting. In Washington and Utah field evaluations during the last 3 years, C5 has demonstrated superiority to available commercial varieties in earliness, fruit set and uniformity of ripening time. C5 plants are smaller than those of most commercial varieties, and the fruit averages about 2 ounces.

The fruit produced by C5 plants has good crack resistance and desired shape but is soft, orange-red in external color, and susceptible to fruit rot.■

Casting Ant Nests in Metal

Molten metal castings of the underground homes of imported fire ants are giving researchers a first-hand look at the nesting habits of this important pest.

The unique metal castings show the rate of colony development, as well as the actual physical changes occurring in the nest itself as the growing ant colony enlarges it.

Recent fire ant studies show that the pest has a limited, rather than indefinite, foraging range, and that neighboring colonies do not exchange food, as was previously assumed. This makes the timing and placement of mirex insecticide baits more crucial. Knowing the rate of colony development can help in determining when to apply the bait most effectively in fire ant control programs.

To cast an older fire ant nest, J. H. Dillier, an agriculturist at the ARS Imported Fire Ant Laboratory, Gulfport, Miss., poured a lead-solder mixture into the large chambers and tunnels. A casting alloy with a low melting point was poured into the smaller, more delicate runways. Both metals flowed through the tunnels for several feet before cooling, usually producing a fairly complete cast of the nest. When the metal cooled the casting was excavated.

Dillier excavated nest castings that ranged from the original brood cell of 10 to 15 small worker ants and a queen, to the cast of a fully matured colony—over 2-years-old with about 70,000 workers.

A brood cell, the first step in forming a colony, is no more than 4 inches deep with a volume of ½ c.c. (0.03 cubic inches). On the other hand, an adult colony has cone-shaped subterranean chambers that extend downward for 3 to 5 feet. The cast of one adult colony had an estimated tunnel and chamber volume of 1 cubic foot.

The imported fire ant, a native of South America, infests more than 100 million acres of Georgia, Alabama, Florida, Louisiana, Mississippi, North Carolina, South Carolina, Arkansas, and Texas. A pest of humans and animals, its venom causes boil-like sores which have hospitalized many victims. The ant eats plant roots, stems, seeds and tender shoots, and its large, hard-crusted mounds damage farm machinery and ruin pastures.

Irradiated Concrete

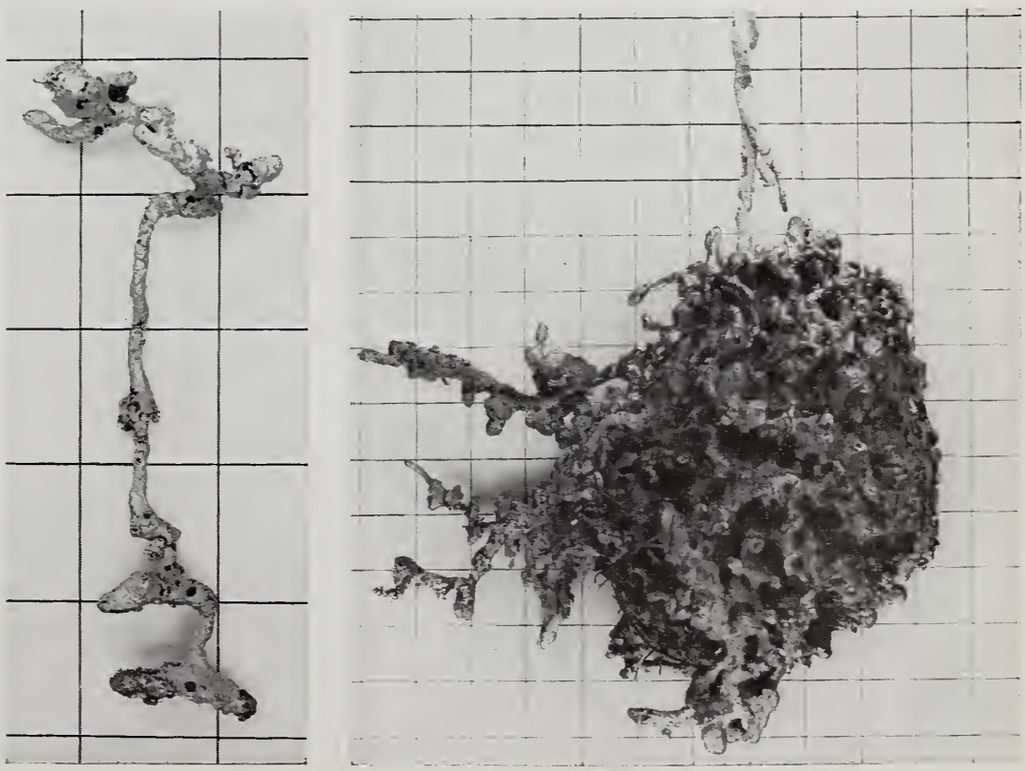
Plastics and concrete can be teamed to make polymer-concrete, a combination material that is 2½ times stronger in bending strength than steel fiber reinforced concrete.

In addition, the material can support five times the weight of regular nonreinforced concrete ordinarily used for foundations and walls.

ARS agricultural engineers J. W. Simons and B. C. Haynes, Jr., at Athens, Ga., are exploring the possibilities of the process in cooperation with the Brookhaven National Laboratory, Atomic Energy Commission, and Georgia Agricultural Experiment Stations.

Polymerized concrete is made by

__Left:__ A fire ant nest 2 to 3 months old with population of 100 to 150 workers (BN-34735). __Right:__ Nest 10 to 12 months old with a population of 20,000 to 25,000 workers. Grid lines in both photos are ½-inch square (BN-34733).



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soaking cured concrete in the monomer (single molecule) methylmethacrylate under vacuum. The material is wrapped in polyethylene film to reduce evaporation loss, then irradiated with cobalt-60 gamma radiation until 100 percent of the monomer has been converted to a polymer (combined molecules). Other monomers are under study.

The research continues at BNL to simplify the treatment and to reduce the time required.

Light Spurs Soybeans

Maybe Jack's beanstalk grew that way because it stood alone, its bottom and middle leaves exposed to direct sunlight.

At least studies at Urbana, Ill., tend to support, in part, such a conclusion.

Light-rich soybean plants in the studies had more seeds, nodes, pods, branches, pods per node, seeds per pod, and a higher oil content than normal plants. Protein content and seed size, however, were reduced by adding light.

Wide-spectrum fluorescent lamps were placed at three levels in the canopies of Amsoy and Wayne varieties, with white reflective polyethylene strips placed between the rows. The lights were used 12 hours during daylight.

Adding light increased the yields of bottom, middle, and top canopy positions of plants 30, 20, and 2 percent, respectively. The small increase in the top leaves probably means that they were already receiving near adequate light.

Results of the experiments give strong support to the need for more light in the soybean canopy. Although shaded middle and lower leaves, when exposed to full sunlight, lack the ability to photosynthesize at rates comparable to young leaves, they could contribute to seed yields if more light were made available to them.

The studies are being continued by agronomists T. J. Johnston, Michigan State University, J. W. Pendleton, University of Illinois, D. R. Hicks, University of Minnesota, and ARS soil scientist D. B. Peters.

October is Co-op Month

During October, American farmers and the Nation will pause to honor cooperatives—the farmer-owned groups that help get better prices for farm products and help rural areas develop their resources.

This year's theme, "Cooperatives: Progress through People," stresses the cooperative idea of giving people a chance to do things for themselves. U.S. farmers turn to member-owned cooperatives for nearly every aspect of their farm business. And cooperatives provide high-quality consumer goods and services, job opportunities, credit, bargaining power, and supplies and technical services to farmers.

ARS supplies a continuous flow of information through its four regional utilization laboratories to keep cooperatives abreast of new and improved methods of utilizing agricultural materials and byproducts. Several such products developed by ARS and now available through cooperatives are apple juice concentrates, instant sweetpotatoes, dehydrated alfalfa, redi-wheat, and processed pine gum.

In a continuous program to help the farmer and the farm cooperative, ARS researchers are developing better techniques for controlling air and stream pollution, utilizing farm waste products, and curbing weed and insect pests. They are also breeding new and better varieties of fruits, grains, and vegetables.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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